POINT COLLOCATION MESHFREE METHOD BASED ON DERIVATIVES APPROXIMATION FOR ELASTICITY

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Point collocation method based on the derivatives approximation of meshfree shape function is applied to solid mechanics in this study. Fast meshfree approximation with approximated derivative of shape function based on moving least square reproducing kernel approximation [1, 2] is reviewed [3], and the formulation of linear elastic solid mechanics by point collocation method is presented. The formulation by point collocation method implies that governing equation of solid mechanics with strong form is directly discretized without no numerical integration cells or grid. Therefore, the errors due to numerical integration are not generated. The regularity of weight function is not required, because the approximated derivative is used unlike other meshfree methods, in which derivatives of shape function must be directly calculated. Therefore we can propose the exponential type weight function that is non-differentiable. The convergence and stability of the proposed method were verified by a generalized patch test. Also, the efficiency and applicability of the proposed method in solid mechanics were verified by application to solving various solid mechanics problems. Numerical results showed that the proposed weight function led to lower error and higher convergence rate than the conventional weight functions did, and that the derivatives approximation enabled the computation of the shape function's derivatives fast and accurate enough to replace the classical direct derivative calculation.

References

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